

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference NJE/G14620WO	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 00/ 00447	International filing date (day/month/year) 11/02/2000	(Earliest) Priority Date (day/month/year) 19/02/1999
Applicant DIGITAL GRAMOPHONE AND WIRELESS LIMITED et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of Invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

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☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/GB 00/00447

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G11B20/00 G11B20/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G11B H03M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	✓ WO 85 04298 A (APPLIED SPECTRUM TECH) 26 September 1985 (1985-09-26) the whole document	1-3,7,8, 10-16
Y	US 5 768 426 A (RHOADS GEOFFREY B) 16 June 1998 (1998-06-16) column 17, line 1 -column 25, line 27; figures 5-8	1-3,7,8, 10-16
A	✓ WO 96 27191 A (STREET ANDREW MICHAEL ; ISIS INNOVATION (GB); EDWARDS DAVID JOHN (G) 6 September 1996 (1996-09-06) the whole document	
A	✓ GB 2 180 725 A (STC PLC) 1 April 1987 (1987-04-01)	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

12 May 2000

Date of mailing of the international search report

22/05/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
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Authorized officer

Devergranne, C

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/00447

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 8504298	A	26-09-1985	US 4672605 A	09-06-1987
			AU 583033 B	20-04-1989
			AU 4110385 A	11-10-1985
			CA 1237545 A	31-05-1988
			EP 0174989 A	26-03-1986
			JP 61501544 T	24-07-1986
			NZ 211474 A	24-02-1989
<hr/>				
US 5768426	A	16-06-1998	CA 2174413 A	26-05-1995
			EP 0737387 A	16-10-1996
			EP 0959620 A	24-11-1999
			EP 0959621 A	24-11-1999
			EP 0987855 A	22-03-2000
			JP 9509795 T	30-09-1997
			WO 9514289 A	26-05-1995
			US 5748763 A	05-05-1998
			US 5850481 A	15-12-1998
			US 5841978 A	24-11-1998
			US 5832119 A	03-11-1998
			US 5862260 A	19-01-1999
			US 5841886 A	24-11-1998
			US 6026193 A	15-02-2000
			US 5745604 A	28-04-1998
<hr/>				
WO 9627191	A	06-09-1996	NONE	
<hr/>				
GB 2180725	A	01-04-1987	NONE	
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F. JOINT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
 United States Patent and Trademark
 Office
 Box PCT
 Washington, D.C.20231
 ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 19 October 2000 (19.10.00)	
International application No. PCT/GB00/00447	Applicant's or agent's file reference NJE/G14620WO
International filing date (day/month/year) 11 February 2000 (11.02.00)	Priority date (day/month/year) 19 February 1999 (19.02.99)
Applicant JONES, Clive et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

14 September 2000 (14.09.00)

☐ in a notice effecting later election filed with the International Bureau on:
2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Olivia TEFY Telephone No.: (41-22) 338.83.38
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PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

ELKINGTON AND FIFE
Prospect House
8 Pembroke Road
Sevenoaks
Kent TN13 1XR
ROYAUME-UNI

Date of mailing (day/month/year) 21 August 2001 (21.08.01)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference NJE/G14620WO	
International application No. PCT/GB00/00447	International filing date (day/month/year) 11 February 2000 (11.02.00)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address

DIGITAL GRAMOPHONE AND WIRELESS
LIMITED
Stonehill
Stukeley Meadows
Huntingdon
Cambridgeshire PE18 6ED
United Kingdom

State of Nationality

GB

State of Residence

GB

Telephone No.

Facsimile No.

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person ☐ the name ☐ the address ☐ the nationality ☐ the residence

Name and Address

MERIDIAN AUDIO LTD
Stonehill
Stukeley Meadows
Huntingdon
Cambridgeshire PE29 6EX
United Kingdom

State of Nationality

GB

State of Residence

GB

Telephone No.

Facsimile No.

Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

<input checked="" type="checkbox"/> the receiving Office	<input type="checkbox"/> the designated Offices concerned
<input type="checkbox"/> the International Searching Authority	<input checked="" type="checkbox"/> the elected Offices concerned
<input checked="" type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

CORTIELLO Maria Victoria

Telephone No.: (41-22) 338.83.38

REC'D 27 MAR 2001

WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference NJE/G14620WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB00/00447	International filing date (day/month/year) 11/02/2000	Priority date (day/month/year) 19/02/1999
International Patent Classification (IPC) or national classification and IPC G11B20/00		
Applicant DIGITAL GRAMOPHONE AND WIRELESS LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 8 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 14/09/2000	Date of completion of this report 23.03.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Sucher, R Telephone No. +49 89 2399 2148 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/00447

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).):*

Description, pages:

1-14 as originally filed

Claims, No.:

1-18 with telefax of 06/03/2001

Drawings, sheets:

1/3-3/3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/00447

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-18
	No:	Claims	
Inventive step (IS)	Yes:	Claims	4,5
	No:	Claims	1-3,6-18
Industrial applicability (IA)	Yes:	Claims	1-18
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1: WO 85 04298 A (APPLIED SPECTRUM TECH) 26 September 1985;
D2: US-A-5 768 426 (RHOADS GEOFFREY B) 16 June 1998.

2. Claim 1 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claim describes a data encoding device for serial data. Each input bit is combined with a plurality of additional encoding bits (forming an encryption key) to derive an encoded output bit and a plurality of updated encoding bits.

Further, "each subsequent input bit is encrypted using an updated key which is derived from previous values of the key and the input bit" which is completely unclear because neither an encryption function nor an "updated" key or "previous values" of a key have been defined. It appears that the updated key is simply formed by the updated encoding bits, and said updated encoding bits are derived from previous encoding bits and the input bit. Each subsequent input bit is then combined with the updated encoding bits, i.e. the original encryption key merely acts as an initial value for the encoding bits.

Still further, "the combination function performed by the encoding unit combines the input bit with a function of the key" which is not clear either because the function of a key is not defined. Concerning the combination function, the claim defines that "over time the encoded output bitstream comprises substantially white noise" which does not enable the skilled person to determine which technical features are necessary to perform the stated function. The technical features necessary for achieving this result should therefore have been added.

A data encoding device having serial data input and encoded serial output, wherein the serial input is supplied to an encoding unit which combines each input bit with a plurality of additional encoding bits to derive an encoded output bit and a

plurality of updated encoding bits, such that the above-mentioned result is achieved, is known from document D1 (see the abstract, fig. 1, and p. 7) and document D2 (see figs. 5 and 6 in conjunction with col. 17, l. 1 - col. 18, l. 29). These documents do not disclose to derive the updated encoding bits from previous encoding bits and the input bit.

However, since neither the original encryption key nor the combination function referred to above are defined in more detail, the claim currently also covers any well-known recursive structure wherein the output bit is derived from an input bit and a previous output bit (like e.g. $y(i) = x(i) \oplus y(i-1)$ with $y(i-1)$ corresponding to an encoding bit to be updated and a random initial value $y(0)$ corresponding to the original encryption key). The subject-matter of claim 1 can therefore not be considered as involving an inventive step in the sense of Article 33(3) PCT.

3. The features added by claims 2, 7, 8, and 10 are known as follows:

a random number generator which generates a plurality of encoding bits for the encoding device (claim 2): see D1, pseudo random code generator 102, and D2, noise source 206;

the input comprises digital audio data (claim 7): see D2, col. 17, l. 9-13;

a transmitter for supplying the encoded serial output signal to an output port (claim 8): see D1, output of transmit path, and D2, output port 234;

a compact disc player (claim 10): see D2, col. 18, l. 26-29.

Thus, the subject-matter of claims 2, 7, 8, and 10 does not meet the requirements of Article 33(3) PCT either.

4. The subject-matter of claims 3, 6, and 9 does not involve an inventive step in the sense of Article 33(3) PCT for the following reasons:

Storing a predetermined number of previous values of the random bit generator in order to derive a multiple bit random word (claim 3) is a well known technique to

the skilled person.

Carrying out the function performed by the encoding unit more rapidly than the time associated with the reception of each input bit from the serial data input is an obvious possibility for the skilled person intending to get the encoded output bit from the input bit with zero delay (claim 6).

A digital audio signal in the SPDIF or AES/EBU format (claim 9) is well known to the skilled person. Using these formats for the output of the device according to D2 which also deals with audio signals would therefore not require any inventive skill.

5. It is clear from the description on pages 8-9 in conjunction fig. 4 and claim 1 that it is essential to the definition of the invention that each input bit is combined with a plurality of encoding bits to derive an encoded output bit and a plurality of updated encoding bits, and said updated encoding bits are derived from previous encoding bits and the input bit.

Since independent claim 16 does not contain these features it does not meet the requirement following from Article 6 PCT taken in combination with Rule 6.3(b) PCT that any independent claim must contain all the technical features essential to the definition of the invention.

However, when clarified in that sense, claim 16 comprises all the features of claim 8 and is therefore not appropriately formulated as a claim dependent on the latter (Rule 6.4 PCT).

The features added by claim 16 (a dedicated clock signal at the input and an intrinsically defined clock signal in the output data, and control data for enabling the audio input to be reconstructed at an associated decoding device) are part of the SPDIF and AES/EBU standard, as acknowledged on p. 1 of the present application. In view of par. 6 above, the subject-matter of claim 16 does therefore not involve an inventive step in the sense of Article 33(3) PCT either. This objection also applies to dependent claims 17 and 18.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/00447

6. Claims 11, 12, and 13 only define a decoding device and apparatus corresponding to the encoding device and apparatus according to claims 1, 2, and 8. Thus, the objections made with respect to claims 1, 2, and 8 are also valid for claims 11, 12, and 13.
7. Speakers for outputting audio signals are well known to the skilled person. Thus, the subject-matter of claim 14 also lacks an inventive step (Article 33(3) PCT).
8. Claim 15 only defines a data communication system comprising a combination of known or obvious devices. In view of fig. 1 of D1, such a system cannot be considered as involving an inventive step in the sense of Article 33(3) PCT either.
9. Claims 4 and 5 define a permutation unit in addition to the random number generator to generate a random word as the encoding bits. With that, the dependence of each random word on the previous random words can be disguised and the "whiteness" of the encoded output stream can be improved. Such a solution is not suggested by the prior art. An appropriately drafted claim based on this feature might therefore meet the requirements of the PCT with respect to novelty and inventive step.

Re Item VII

Certain defects in the international application

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in documents D1 and D2 is not mentioned in the description, nor are these documents identified therein.
2. The independent claims are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art being placed in a preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in a characterising part (Rule 6.3(b)(ii) PCT).
3. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/00447

Re Item VIII

Certain observations on the international application

see item V.

CLAIMS

1. A data encoding device having a serial data input and an encoded serial data output, wherein the serial input is supplied to an encoding unit which combines each input bit with a plurality of additional encoding bits forming an encryption key, to derive an encoded output bit and a plurality of updated encoding bits, wherein each subsequent input bit is encrypted using an updated key which is derived from previous values of the key and of the input bit, and wherein the combination function performed by the encoding unit combines the input bit with a function of the key, such that over time the encoded output bit stream comprises substantially white noise.
2. A data encoding device as claimed in claim 1, wherein a random number generator is provided which generates a stream of bits, an initial plurality of encoding bits being derived from the output of the random number generator for initialisation of the encoding device.
3. A data encoding device as claimed in claim 2, wherein each random bit is provided to a transformation unit comprising means for storing a predetermined number of previous values of the random bit to derive a multiple bit random word.
4. A data encoding device as claimed in claim 3, wherein the random word is supplied to a permutation unit which generates the initial plurality of encoding bits.
5. A data encoding device as claimed in claim 4, wherein the serial input comprises a string of digital words each comprising a predetermined number of bits, and wherein the random number generator is clocked using a word clock, such that for each digital word of the input a new random bit is generated, and wherein the encoding unit is re-initialized by the output of the permutation unit once for each word.
6. A data encoding device as claimed in claim any preceding claim, wherein the combination performed by the encoding unit is carried out more rapidly than the time associated with the reception of each input bit from the serial data input, such that the encoded

output bit represents the input bit with zero bit delay.

7. A data encoding device as claimed in any preceding claim, wherein the input comprises digital audio data.

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8. An apparatus for generating digital audio data comprising a source of digital audio signals, a data encoding device as claimed in any preceding claim, and a transmitter for supplying the encoded serial data output to an output port of the apparatus.

10 9. An apparatus as claimed in claim 8, wherein the output at the output port is in SPDIF or AES/EBU format.

10. An apparatus as claimed in claim 8 or 9, comprising a compact disc player.

15 11. A data decoding device for decoding a serial data stream encoded by an encoding device of any one of claims 1 to 7, wherein the stream of input bits is supplied to a decoding unit which combines each encoded input bit with a plurality of additional decoding bits, to extract a decoded output bit and an updated plurality of decoding bits.

20 12. A data decoding device as claimed in claim 11, wherein a random number extractor is provided for extracting a random number from the input to the decoding device and which provides a plurality of decoding bits for initialisation of the decoding device.

25 13. An apparatus for reconstructing digital audio signals comprising an input for receiving encoded digital audio signals, a receiver for supplying the encoded digital audio signals to a decoding device as claimed in claim 11 or 12, and an output for the reconstructed digital audio signal.

14. An apparatus as claimed in claim 13, comprising a speaker.

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15. A data communications system comprising an apparatus as claimed in claim 8, 9 or 10

for providing an encoded digital audio output, and an apparatus as claimed in claim 13 or 14 for reconstructing the digital audio signal.

16. An apparatus for encoding digital audio signals, the apparatus having an audio input in a format having a dedicated clock signal channel and an encoded audio output in a format having an intrinsically defined clock signal in the output data stream, wherein the audio input is encoded such that the encoded audio output comprises substantially white noise, and the output of the apparatus additionally comprises control data for enabling the audio input to be reconstructed at an associated decoding device.

17. An apparatus as claimed in claim 16, wherein the output format having an intrinsically defined clock signal comprises the SPDIF or AES/EBU data format.

18. An apparatus as claimed in claim 16 or 17, wherein the format having a separate clock channel comprises the I²C data format.

CLAIMS

1. A data encoding device having a serial data input and an encoded serial data output, wherein the serial input is supplied to an encoding unit which combines each input bit with a plurality of additional encoding bits, to derive an encoded output bit and a plurality of updated encoding bits, the function performed by the encoding unit being selected such that over time the encoded output bit stream comprises substantially white noise.

2. A data encoding device as claimed in claim 1, wherein a random number generator is provided which generates a stream of bits, an initial plurality of encoding bits being derived from the output of the random number generator for initialisation of the encoding device.

3. A data encoding device as claimed in claim 2, wherein each random bit is provided to a transformation unit comprising means for storing a predetermined number of previous values of the random bit to derive a multiple bit random word.

4. A data encoding device as claimed in claim 3, wherein the random word is supplied to a permutation unit which generates the initial plurality of encoding bits.

5. A data encoding device as claimed in claim 4, wherein the serial input comprises a string of digital words each comprising a predetermined number of bits, and wherein the random number generator is clocked using a word clock, such that for each digital word of the input a new random bit is generated, and wherein the encoding unit is re-initialized by the output of the permutation unit once for each word.

6. A data encoding device as claimed in claim any preceding claim, wherein the encoded output bit represents the input bit with zero bit delay.

7. A data encoding device as claimed in any preceding claim, wherein the input comprises digital audio data.

8. An apparatus for generating digital audio data comprising a source of digital audio signals, a data encoding device as claimed in any preceding claim, and a transmitter for supplying the encoded serial data output to an output port of the apparatus.
- 5 9. An apparatus as claimed in claim 8, wherein the output at the output port is in SPDIF or AES/EBU format.
10. An apparatus as claimed in claim 8 or 9, comprising a compact disc player.
- 10 11. A data decoding device for decoding a serial data stream encoded by an encoding device of any one of claims 1 to 7, wherein the stream of input bits is supplied to a decoding unit which combines each encoded input bit with a plurality of additional decoding bits, to extract a decoded output bit and an updated plurality of decoding bits.
- 15 12. A data decoding device as claimed in claim 11, wherein a random number extractor is provided for extracting a random number from the input to the decoding device and which provides a plurality of decoding bits for initialisation of the decoding device.
- 20 13. An apparatus for reconstructing digital audio signals comprising an input for receiving encoded digital audio signals, a receiver for supplying the encoded digital audio signals to a decoding device as claimed in claim 11 or 12, and an output for the reconstructed digital audio signal.
- 25 14. An apparatus as claimed in claim 13, comprising a speaker.
15. A data communications system comprising an apparatus as claimed in claim 8, 9 or 10 for providing an encoded digital audio output, and an apparatus as claimed in claim 13 or 14 for reconstructing the digital audio signal.
- 30 16. An apparatus for encoding digital audio signals, the apparatus having an audio input in a format having a dedicated clock signal channel and an encoded audio output in a format

having an intrinsically defined clock signal in the output data stream, wherein the audio input is encoded such that the encoded audio output comprises substantially white noise, and the output of the apparatus additionally comprises control data for enabling the audio input to be reconstructed at an associated decoding device.

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17. An apparatus as claimed in claim 16, wherein the output format having an intrinsically defined clock signal comprises the SPDIF or AES/EBU data format.

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18. An apparatus as claimed in claim 16 or 17, wherein the format having a separate clock channel comprises the I²C data format.